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EXPERIMENTAL STUDIES ON TENSILE PROPERTIES OF JUTE FIBRE REINFORCED POLYMER COMPOSITES

G. MUSALAIAH[1], BADE VENKATA SURESH[2], B. PRASHANTH[3] & B. DHANRAJ[4]

[1]*Department of Mechanical engineering, Institute of Aeronautical Engineering, Dundigal Hyderabad, India*

[2]*Department of Mechanical Engineering, GMR Institute of Technology, Rajam, Andhra Pradesh, India*

[3]*Department of Mechanical Engineering, MLR Institute of Technology, Dundigal, Hyderabad, India*

[4]*Department of Mechanical Engineering, Vardhaman College of Engineering, Shamshabad, Hyderabad, India*

ABSTRACT

As reinforcement material, jute fibre is used to develop reinforced plastics for the purpose of various engineering applications. Just because of its acceptable mechanical properties, low cost and biodegradability, it is chosen as reinforcement material. The mechanical properties of polymeric matrix composites based on jute fibre-reinforced polymer composites have played a dominant role for a long time, in a variety of applications for their high specific strength and modulus. In the present work, mechanical properties of the composites, such as Tensile strength and tensile modulus were measured in dependence of fibre content.

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Original Article

INTRODUCTION

Jute is one of the best natural fibre in various engineering applications and it is second largest producer in the country after cotton it comes under the best fibre category. Raw jute is the industrial name of jute. The fibres of jute are usually3 feet to 13 feet long, Gassan, J et.al.,[1] identified the mechanical properties of natural-fibre-reinforced thermo sets, as a result of optimization of the properties of tossa jute fibres by the use of a NaOH treatment process. Gassan, J et.al.,[2] studied the effectiveness of MAH-PP copolymers (graft copolymer of PP and maleic anhydride) as coupling agents in jute-polypropylene composites. Karmaker, A. C.,et.al.,[3] SYNOPSIS Composites with polypropylene (PP) and jute fiber were prepared by injection molding technique. Maleic anhydride-grafted polypropylene was added as coupling agent to improve the adhesion between jute fiber and PP. Senthilkumaar, S., et.a;.,[4] investigated the Feasibility of employing this jute fiber activated carbon (JFC) for the removal of Methyleneblue (MB) from aqueous solution. Plackett, D., et.al.,[5] Examined of composite fracture surfaces using electron microscopy showed voids occurring between the jute fibre bundles and the polylactide matrix in some cases. Size exclusion chromatography revealed that only minor changes in the molecular weight distribution of the polylactide occurred during the process. Rana, A. K.,[6] studied that with the use of compatilizerflexural strength and tensile as high as 100% and 120%, respectively and impact strength with unnotched by 175%. Gowda, T. M. et.al.,[7] evaluated the mechanical properties of woven jute fabric reinforced composites Jawaid, M., et.al.,[8] produced hybric composites by a technique called, hand lay-up by reinforcing oil palm and jute fibres along with epoxy and identified that the tensile properties are improved, Acha, B. A et.al. [9] studied the dynamic mechanical response and the short term creep-recovery behavior of composites made from bi-directional jute fabrics and polypropylene. Rahman, M. R et.al.,[10] manufactured composites by injection

molding. The raw fibre was manufactured composites and oxidized is post treated with urotropine.

PROPOSED METHOD OF STUDY

Composite Preparation

For composite Processing, Hand lay-up technique is the best method. The processing of this technique is very simple and processing requirements are also very less. Initially, the mold surface is prepared with wood and release gel is sprayed on it to avoid polymer to stick on its surface. In order to get good surface finish of the product, thin plastic sheets are placed at the bottom and top of the mold. Now, the reinforcement is cut into pieces as per the size of the mold. Then, liquid form of thermosetting polymer is mixed with suitable hardener thoroughly, and slowly poured on the mat surface. With help of brush, uniformly spreading of polymer has to be done. After that, second layer of mat is taken and a roller is passed over it with some pressure to avoid air gaps. The entire process is repeated, until the required layers are obtained. After that, top mold plate is covered with plastic sheet by spraying release gel. By leaving the entire set up in room temperature or at specific temperature, the produced composite are collected and transferred for further process. The schematic representation of hand lay-up is shown in figure 1. The time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperature is 24-48 hours.

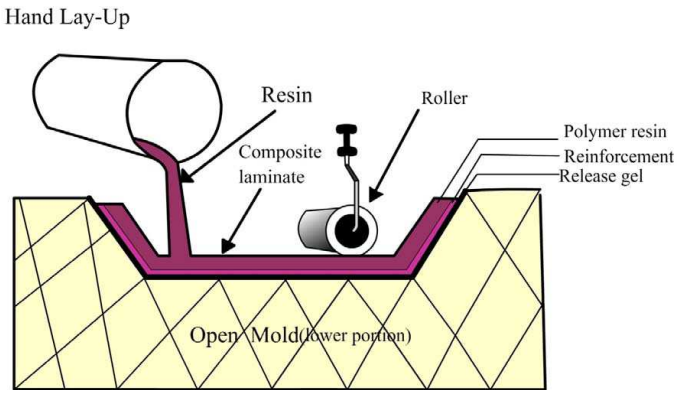

Figure 1: Hand Lay-Up Technique

Jute Fibre Chemical Treatment

Initially, the jute was cut into uniform standards of 200mm, and stored in a dry place. Then, taken to the laboratory and the jute was immersed in the distilled water and the pH value of the setup was checked, and it was observed around 6.20 and now, treated with alkaline solution to increase PH up to 7.00. The selected alkaline solution was NaoH. Taking 2% of NaoH in a beaker of pure distilled water, jute standards were immersed to 30 min. And then, the pH value of it was checked, the PH gave 7.00 on PH meter. Then Stirring was stopped and taken out the jute, and air dried for 2 hours. Blower was used to blow the air for removing moisture and they were stored in a dry place.

RESULTS AND DISCUSSIONS

Tension Test

Tensile test was conducted at GITAM University and the results are tabulated in table 2. The Tensile test on the specimen of the dimensions 200mm ×12mm × 12mm was done by using Hydraulic Operated Computerized Universal Testing Machine (UTM) of measuring capacity of (±100kN), with 150mm of usable stroke. It was designed for both static and dynamic testing on a variety of a materials and components.

Tensile test specimen specification:

Length : 200mm

Breath : 12mm

Height : 12mm

Table 1: Tensile Test on Jute Composite

Company	Gitam University
Laboratory Name	Mechanical Testing Lab
Rate 1	5.00000 mm/min

Table 2: Raw Specimen Tensile Test on Glass Composite

S. No	Time (sec)	Load (N)	Extension (mm)	Tensile strain (mm/mm)	Tensile stress (MPa)	Tensile Extension (mm)
1.	1	0.08	0.02	0.00021	0.54529	0.01985
2.	2	0.15	0.04	0.00038	1.04734	0.03571
3.	3	0.22	0.05	0.00056	1.50581	0.0533
4.	4	0.28	0.07	0.00073	1.96027	0.06892
5.	5	0.34	0.08	0.00088	2.34812	0.08318
6.	6	0.4	0.1	0.00109	2.79997	0.10328
7.	7	0.46	0.12	0.00124	3.22254	0.11767
8.	8	0.53	0.13	0.00141	3.65017	0.13434
9.	9	0.58	0.15	0.00159	4.0572	0.1507
10.	10	0.64	0.17	0.00178	4.43548	0.16927
11.	11	0.7	0.19	0.00197	4.83092	0.18685
12.	12	0.75	0.2	0.00212	5.21742	0.20171
13.	13	0.81	0.22	0.00232	5.60289	0.22
14.	14	0.86	0.23	0.00247	5.97322	0.23498
15.	15	0.91	0.25	0.00266	6.33939	0.25289
16.	16	0.96	0.27	0.0028	6.69111	0.26642
17.	17	1.02	0.29	0.00302	7.07665	0.28697
18.	18	1.07	0.3	0.0032	7.45515	0.30415
19.	19	1.12	0.32	0.00336	7.79858	0.31943
20.	20	1.17	0.33	0.00351	8.11085	0.3339
21.	21	1.22	0.35	0.00372	8.49762	0.35311
22.	22	1.28	0.37	0.00391	8.86742	0.37128
23.	23	1.32	0.38	0.00406	9.16173	0.38562
24.	24	1.37	0.4	0.00423	9.5132	0.40163
25.	25	1.42	0.42	0.00439	9.83576	0.4174
26.	26	1.47	0.43	0.00456	10.19956	0.43361
27.	27	1.51	0.45	0.00477	10.51087	0.45355
28.	28	1.56	0.47	0.00495	10.82293	0.47062
29.	29	1.6	0.49	0.00513	11.14539	0.48781
30.	30	1.65	0.5	0.00528	11.4823	0.50176
31.	31	1.7	0.52	0.00546	11.8087	0.51887
32.	32	1.74	0.53	0.00563	12.10517	0.5352
33.	33	1.79	0.55	0.00582	12.42126	0.55251
34.	34	1.83	0.57	0.00599	12.74099	0.56938
35.	35	1.89	0.59	0.00618	13.09138	0.58685
36.	36	1.92	0.6	0.00634	13.36432	0.60217
37.	37	1.97	0.62	0.00649	13.66789	0.61689
38.	38	2.01	0.64	0.00672	13.98091	0.63811
39.	39	2.06	0.65	0.00686	14.29758	0.65218

Table 2: Contd.,						
40.	40	2.09	0.67	0.00704	14.52788	0.66881
41.	41	2.14	0.68	0.0072	14.84737	0.68413
42.	42	2.18	0.7	0.0074	15.16572	0.70346
43.	43	2.23	0.72	0.00757	15.45727	0.71888
44.	44	2.26	0.74	0.00775	15.6798	0.73597
45.	45	2.3	0.75	0.00792	15.99189	0.75193
46.	46	2.35	0.77	0.0081	16.30155	0.76922
47.	47	2.39	0.78	0.00827	16.58927	0.78561

Graph

Tabulated Tensile values were plotted according to above table 2. The graphs are plotted to understand pictorially, whether there is increment or decrement in the tensile values on the specimen. Figure 2 shows the Graphs are plotted between Tensile stress (N/mm^2) (Y-axis) and Tensile strain (X-axis) as follows.

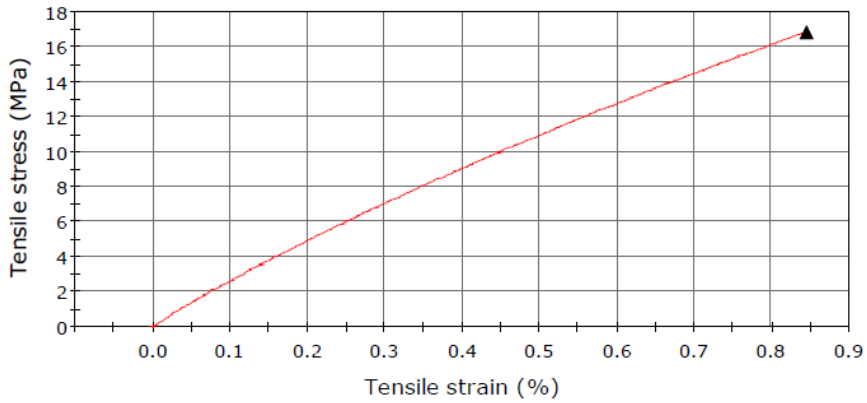

Figure 2: Stress vs. Strain Graph of Tension Test

Table 3: Tensile Test on the Specimen

S. No	Specimen Label	Maximum Load (KN)	Load at Break(KN)	UTS (MPa)	Load at 2% Strain (KN)	Modulus (E -Modulus) MPa
1	Jute	2.42052	2.42	16.81	5.69	19.776

The initial load of 0.02N to the maximum load of 2.42N is given for the experiment. At the maximum load of 2.42052N, the breaking point occurs. The tensile extensions for initial and final values are 0.00204mm and 0.8016mm, respectively. The tensile stress and strain values for initial conditions are 0.0058MPa and 0.00002, respectively and for final conditions are 16.8092MPa and 0.00844, respectively. The initial values are taken at the time 0.0008 sec and the final values are taken at 47.9 sec.

The values of stress, strain and young's modulus for Tensile are as follows.

Tensile Test:

Yield Stress : 5.3 MPa

Tensile Stress : 16.81MPa

Strain : 5.69

Young's Modulus : 19.776MPa

CONCLUSIONS

The values of stress, strain and young's modulus of tensile test were obtained by mixing the jute with epoxy resin and epoxy hardener. The ratio of epoxy resin to epoxy hardener used in this composite was 10:1. Due to this ratio, young's modulus of the composite increased. And, efficient methodology was established. With the above results, it is cleared that the tensile properties of the jute fibre reinforced composites are increasing, and it is biodegradable and there will be no effect on the environment.

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